by the process C is found to have been improved by about 1.6 times as compared with that formed by the process A.

If an attempt is made to obtain an insulation film having a film quality equivalent to that of the present embodiment by the process B or C, it is required to increase the irradiation time or to increase the irradiation quantity. In this case, it is found that a treatment time is increased, productivity is lowered, the insulation film with low relative dielectric constant is not obtained by an excessive electron beam irradiation, or the bridge reaction of the precursor is not well achieved, and an insulation film having desired film quantity cannot be obtained.

In the present embodiment, the insulation film having low relative dielectric constant and excellent crack resistance properties is obtained by well combining the processes B and C with each other, i.e., by combining the heat treatment and the electron beam irradiation treatment, and by changing the pressure to two stages.

FIG. 3 shows spectrum intensities obtained by a Fourier transform infrared-ray spectroscopy (FT-IR) of the insulation films (polymethyl siloxane film) formed by the respective processes. In FIG. 3, spectrum intensities of the three insulation film is arranged vertically for ease of comparison. A FT-IR spectrum of

the insulation film formed by the process B is nearly identical that of the insulation film formed by the process C.

It is evident from FIG. 3 that the insulation film formed by the process of the present embodiment and the process C is small in peak intensity of $Si-CH_3$ bonding in the vicinity of a wave number of 1300 cm^{-1} as compared with the insulation film formed by the process A. This indicates that bonding between a CH_3 group and a primary chain in a molecule has been cut by the electron beam irradiation in the case of the present embodiment and the process C.

In addition, it has been evident that, in the insulation film formed by the process A, a separation of Si-O bonding peak intensity is significant in a vicinity of wave numbers of 1050 cm^{-1} and 1150 cm^{-1}. This indicates that a straight chain shaped Si-O bonding exists in the insulation film. In contrast, in the insulation films formed by the process of present embodiment and the process C, the separation of Si-O bonding is gentle. This indicates that the straight chain shaped bonding has been broken, and complex Si-O bonding has been formed.

Further, in the insulation film formed by process C, there appears a large peak caused by H_2 O bonding in the vicinity of a wave number of 3500 cm^{-1} and Si-OH bonding in a vicinity of a wave number of 980 cm^{-1}, but

in the insulation films formed by the process of present embodiment and process A, almost no peak appears in the vicinity of the above wave number.

From these facts, in the case process C, it is considered that a sufficient dehydration reaction is not carried out, and a number of Si-OH bonding and H_2O remains in the insulation film.

Namely, in the process C, the cutting of CH_3 in a vicinity of a surface of the insulation film is accelerated by the electron beam irradiation, and sufficient dehydrate reaction occurred, but sufficient dehydrate reaction did not occur in the entire insulation film, and this is considered as a reason why the insulation film formed by the process C does not have a low relative dielectric constant. On the other hand, a strong network is formed in the vicinity of the surface, and this is considered as a reason why the mechanical strength of the insulation film formed by the process C is improved.

On the other hand, in the insulation film formed by the process of the present embodiment, there appears neither a peak caused by H_2O bonding in the vicinity of the wavelength of 3500 cm^{-1} nor a peak caused by Si-OH bonding in the vicinity of the wavelength of 980 cm^{-1}. Namely, heat treatment is carried out at the same time as the electron beam irradiation, and changing the pressure, whereby bonding between the CH_3